



| | | |
|--|-----------------------------|---------------|
| STS-114 Flight Readiness Review | Presenter Alex Adams | |
| | Date June 30, 2005 | Page 1 |

Space Shuttle Program Safety & Mission Assurance Office



STS-114 CoFR Endorsement

Presenter **Alex Adams**

Date **June 30, 2005** Page **2**

G - Standard Open Work or Completed

Y - Open Issues With A Plan Resolution

R - Constraint for STS-114 Flight

| S&MA Flight Preparation Element | S&MA Endorsement Statement | Stoplight Status | Exceptions/Constraints: |
|---|---|------------------|---|
| Hazard Analysis and Reports | Hazard Analysis and Reports have been verified to have valid hazard causes, controls and verification. | Y | Orbiter, Integration, SRB, ET, SSME and RSRM Open Work (B/U 17 thru 21) |
| Critical Items List | Critical Item List (CIL) have been verified to have valid criticality, effects & operational controls. | Y | Orbiter, SRB, ET, RSRM and Launch & Landing Open Work (B/U 22 thru 23) |
| Certification | Certification of hardware requirements have been verified and documented. | Y | Orbiter, Integration, EVA & GFE and ET Open Work: i.e. OBSS/RMS Over-Torque, Critical Debris Requirement and CIPA Triple-Level Containment (B/U 24 thru 25) |
| Risk, Probabilistic, Reliability, Maintainability and Supportability Analysis | Any flight specific risk, probability, reliability, maintainability, and supportability analysis findings impacting safety or mission success have been resolved. | G | |
| Audits/Surveillance Findings | Any flight specific audit or surveillance findings impacting safety and mission success have been resolved. | G | |
| ICDs | Changes to Interface Control Documents (ICDs) have been verified to not invalidate certification, hazard controls, or CIL rationale. | Y | Trunking Radio Interference with Range Safety System (B/U 26) |



STS-114 CoFR Endorsement

Presenter **Alex Adams**

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G - Standard Open Work or Completed

Y - Open Issues With A Plan Resolution

R - Constraint for STS-114 Flight

| S&MA Flight Preparation Element | S&MA Endorsement Statement | Stoplight Status | Exceptions/Constraints |
|----------------------------------|---|------------------|--|
| Hardware and Software Acceptance | Hardware and Software requirements have been reviewed and any discrepancies between as-built vs. as designed verification has been disposition. | G | |
| NSTS 08171, OMRSD | RCNs to Operations & Maintenance Requirement Specification Document (OMRSD) have been verified to not invalidate Hazard and CIL controls. | G | |
| Launch Commit Criteria | Launch Commit Criteria (LCC) changes have been verified not to invalidate hazard controls or CIL retention rationale. | Y | CE-01 LCC: ET Ice Allowables Conditions (NSTS-08303) |
| Flight Rules | Flight rules changes have been verified not to invalidate hazard controls or CIL rationale. | G | |
| Crew Procedures | Crew Procedures changes have been verified not to invalidate hazard controls or CIL rationale. | G | |
| Integrated Vehicle Readiness | Integrated Vehicle has been assessed through GMIPS, surveillance, and audits and satisfactorily dispositioned. | G | |



STS-114 CoFR Endorsement

Presenter **Alex Adams**

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G - Standard Open Work or Completed

Y - Open Issues With A Plan Resolution

R - Constraint for STS-114 Flight

| S&MA Flight Preparation Element | S&MA Endorsement Statement | Stoplight Status | Exceptions/Constraints |
|---|--|------------------|---|
| PRACA Reportable Items (H/W & S/W) | Hardware/Software program problem reporting and corrective action reportable items applicable to this mission have been disposition. | Y | Orbiter, SRB, ET, and SSME Open Work (B/U 27) |
| Waivers and Deviations (Level II/Level III) | Waivers, Exceptions and Deviations, have been verified to be acceptable for flight and any violation of any existing certification, hazard, and CIL rationale is documented. | Y | Debris Prevention NSTS 07700, Vol. X Book1, paragraph 3.2.1.2.14 (B/U 28) |
| Limited Life | Flight hardware records have been verified to determine hardware is within time, cycle, and age life and technical accuracy of limited life analysis is acceptable. | Y | SRB Limited Life/Shelf Life Issue: CDF Manifolds (Lot ABE) expiration date of 6/30; Extension Testing completed. Lot certification ECD 6/28/05. (B/U 29) |
| MRBs | Material Review Boards (MRB) items requiring NASA S&MA disposition have been approved. | G | |
| Alerts | Alert notices have been assessed for applicability to this mission and have been disposition. | G | |
| Mission Support | S&MA personnel supporting L&L, flight support, Mishap Investigation Team, and Mishap Rapid Response Team have been identified, trained, and qualified to support. | G | |



STS-114 CoFR Endorsement

Presenter **Alex Adams**

Date **June 30, 2005** Page **5**

G - Standard Open Work or Completed

Y - Open Issues With A Plan Resolution

R - Constraint for STS-114 Flight

| S&MA Flight Preparation Element | S&MA Endorsement Statement | Stoplight Status | Exceptions/Constraints |
|---------------------------------|--|------------------|------------------------|
| Element Acceptance Review | All S&MA actions, issues, and Open Work are closed | G | |
| ET/SRB Mate Readiness | All S&MA actions, issues, and Open Work are closed | G | |
| Rollout/ET Mate Readiness | All S&MA actions, issues, and Open Work are closed | G | |
| S&MA Preflight Readiness Review | Any exceptions have been brought forward to Program manager for resolution | G | |

| Independent Safety Reporting | Summary Description | Stoplight Status | Remarks |
|-------------------------------------|---|------------------|-----------------------|
| NASA Safety Reporting System (NSRS) | All reported items with flight impact have been closed. | G | See Page 6 for status |



NASA Safety Reporting System

Presenter **Alex Adams**

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| Status date: 6-20-05 | | | |
|----------------------|-------------------------------|---|-------------------------|
| NSRS # | Constraint to STS-114 Launch? | Long-term action required (post-STS-114)? | NSRS Status for STS-114 |
| 565 | No | Yes | G |
| 566 | No | Yes | G |
| 568 | No | | G |
| 569 | No | | G |
| 570 | No | Yes | G |
| 596 | No | Yes | G |
| 600 | No | Yes | G |
| 601 | No | | G |
| 607 | No | | G |
| 614 | No | Yes | G |
| 616 | No | Yes | G |
| 619 | No | Yes | G |
| 622 | TBD | Yes | Y |
| 624 | No | Yes | G |
| 626 | No | Yes | G |
| 628 | No | Yes | G |

Status:

- OSMA held weekly NSRS Work Group telecon.
 - Included SSP SMA, NASA SMA, and OSMA participants.
- Yellow NSRSs have not been formally closed but have been reviewed by NSRS Working Group.
 - No launch constraint is expected.

Planned Work:

- Internal OSMA NSRS process update.
- Reinstate NSRS as formal CoFR element in next CoFR update.

| Key | |
|----------|---|
| G | Assessed for this flight and no launch constraint |
| Y | Assessment in process and no launch constraint expected |
| R | Assessment in process and launch constraint expected |



| | | |
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| STS-114 Baselined Hazard Cause Classification | Presenter Alex Adams | |
| | Date June 30, 2005 | Page 7 |

HAZARD SEVERITY AND LIKELIHOOD OF OCCURRENCE WITH CONTROLS IN PLACE

| | | | | |
|------------|------------|----------|----------|--------------|
| Likelihood | PROBABLE | | | 0 |
| | INFREQUENT | 3 | 2 | 29 |
| | REMOTE | 64 | 22 | 336 |
| | IMPROBABLE | 163 | 529 | 4092 |
| | | MARGINAL | CRITICAL | CATASTROPHIC |

Probable x Catastrophic Causes

- none

Infrequent x Catastrophic Causes

- Debris (18-Causes)
- Lightning (4-Causes)
- Hazardous Condition in the Aft Compartment (3-Causes)
- Ascent Trajectory Anomaly (1-Cause)
- Hazardous Environment due to H2 External to SSV (1-Cause)
- Water Spray Boiler (1-Cause)
- Fire/Explosion in Aft (1-Cause)

Total Causes
Accepted Risk: 392
Controlled Risk: 4848

Severity Levels



| | | |
|--|-----------------------------|---------------|
| STS-114 Infrequent x Catastrophic Hazard Causes | Presenter Alex Adams | |
| | Date June 30, 2005 | Page 8 |

Systems Engineering & Integration

- **IGNC-01—Ascent Trajectory Anomaly (1 - Cause)**

- Cause AQ - Critical Math Model used for Design/Verification does not match flight conditions causing trajectory anomaly

Rationale for Increase in Risk: Previously Critical Math Models were not considered a cause.

- **IMEO-01—Hazardous Condition in the Aft Compartment (3 - Causes)**

- Cause G - Hot sources in the Aft Compartment from Improper Design/Interface Characteristics
- Cause AP - Leakage in the Aft Compartment from External Sources
- Cause AS - Ignition Sources in the Aft Compartment from External Sources

Rationale for Increase in Risk: Aggregate risk associated with number of leakage sources

- **IMPS-09—Hazardous Environment due to H2 External to SSV (1 - Cause)**

- Cause AC - H2 Concentrations above Lower Flammability Limit External to the SSME due to Failure to Disperse Lag H2 during Pad Shutdown.

Rationale for Increase in Risk: Uncertainty associated with dispersion of lag H2 after a pad abort

- **ILIT-01—Failure to Avoid Lightning (4 - Causes)**

- Cause B - Failure to Avoid Lightning During Pre-launch Operations Between the VAB and the Launch Pad
- Cause C - Failure to Avoid Lightning During Pre-launch Operations at the Launch Pad
- Cause E - Failure to Avoid Lightning During Entry/Descent/Landing
- Cause F - Failure to Avoid Lightning During Post-landing Through OPF Roll-In

Rationale for Increase in Risk: Limitations in controls for equipment protection combined with increased understanding of lightning environment.



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| STS-114 Infrequent x Catastrophic Hazard Causes | Presenter Alex Adams | |
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Systems Engineering & Integration

• IDBR-01—External Debris Impact to SSV (13 - Causes)

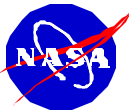
Tile Impacts

- 2-Foam Causes
 - LO2 Tank Ice/Frost Ramps
 - Intertank Ice/Frost Ramps
- 1-Ice Cause which covers ET defects, I/F ramps, SRB cable tray expansion joints, Umbilical cable tray drain holes, SRB fittings, Acreage, LH2 burst disk, TPS repairs, machined areas, and under insulated areas (22 Sources)
- 1-Causes for Feedline Bellows Ice (3 Sources)
- 1-Cause for ET Umbilical Ice (7 Sources)
- 1-Cause for ET Bracket Ice

Special Tile Impacts (*Umbilical/Landing Gear Doors*)

- 1-Causes for Feedline Bellows Ice (3 Sources)
- 1-Cause for ET Umbilical Ice (7 Sources)
- 1-Cause for ET Bracket Ice
- 1-Ice Cause which covers ET defects, I/F ramps, SRB cable tray expansion joints, Umbilical cable tray drain holes, SRB fittings, Acreage, LH2 burst disk, TPS repairs, machined areas, and under insulated areas (22 Sources)
- 3-Foam Causes
 - LO2 Tank Ice/Frost Ramps
 - Intertank Ice/Frost Ramps
 - LO2 to Intertank Flange Closeout

Rationale for Increase in Risk: Uncertainty associated with use-as-is foam and ice.



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| STS-114 Infrequent x Catastrophic Hazard Causes | Presenter Alex Adams | |
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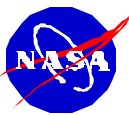
Orbiter

- **ORBI 007—Loss of Outer Moldline Due to Debris Impact (1 – Cause)**
 - Cause M - MMOD Impacting the Orbiter

Rationale for Increase in Risk: No change in risk classification. RCC damage tolerance increased likelihood of hazard.
- **ORBI 344—Water Spray Boiler System Failures Could Cause Loss of 2 APU Systems (1 – Cause)**
 - Cause A - Water or PGME/Water Flow Path Blockage or Restricted Flow Due to Low Pressure Environmentally Induced Freezing Following Ascent Operation

Rational for Increase in Risk: Significant flight history of WSB freeze-up resulting in a risk of multiple APU loss.
- **ORBI 036—Fire/Explosion in Aft Compartment Caused by Leakage of a Flammable Fluid Coming Into Contact with APU/Exhaust Duct Hot Surfaces (1 – Cause)**
 - Cause A: Limitations of Insulation Design Permit Exposure of Orbiter Fluids/Vapors to APU Hot Surfaces

Rationale for Increase in Risk: Aggregate risk associated with number of leakage sources



| | | |
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| STS-114 Infrequent x Catastrophic Hazard Causes | Presenter Alex Adams | |
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External Tank

- **T.02—ET Loss of TPS (3 – Causes)**

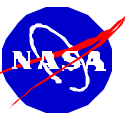
- Cause 6 - Manual foam (sprayed) applications deficiencies for non-redesigned ET locations
- Cause 9 - Manual foam (poured) applications deficiencies
- Cause 14 - Divoting due to internal voids for ET non-redesigned applications

Rationale for Increase in Risk: Uncertainty in manual use as is applications.

- **T.04—ET Ice Debris (1 – Cause)**

- Cause 2 – As-designed un-insulated ET surfaces exposed to cryogenic temperatures

Rationale for Increase in Risk: Uncertainty in ice environment.



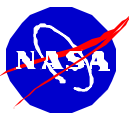
Dissenting Opinions

Presenter **Alex Adams**

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- **Dissenting Opinion T-0 Umbilical loss of electrical continuity**

- **Issue:** Potential Catastrophic risk from the common cause failure resulting in inadvertent plate/pin/socket separation and loss of electrical continuity to the SRB Hold Down Post Pyrotechnic Initiator Controller Fire 1 & 2, and Return paths across the T-O Umbilical due to the dynamic vibro-acoustic environment from SSME startup through T-0



Summary

Presenter **Alex Adams**

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• **Significant Open Work**

- Hazard Reports
- CILs
- Certification
- PRACA
- ICD
 - Trunking Radio Interference with Range Safety System
- Launch Commit Criteria (LCC)
 - CE-01 LCC: ET Ice Allowables Conditions (NSTS-08303)
- Waiver
 - Debris Prevention (NSTS 07700, Vol. X Book1, paragraph 3.2.1.2.14)
- Limited Life
 - SRB Limited Life/Shelf Life Issue:
CDF Manifolds (Lot ABE) expiration date of 6/30; Extension Testing completed. Lot certification ECD 6/28/05.



STS-114 CoFR Endorsement

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- Pending completion of the identified planned open work and closure/acceptance of exceptions, Safety and Mission Assurance is ready to proceed with the launch.

Terry Wilcutt
SSP S&MA
Manager

Scott Johnson
JSC S&MA SSP
Chief Engineer

David Thelen
JSC S&MA SSP
Division Chief

David Petri
JSC S&MA Flight Equipment
Division Chief

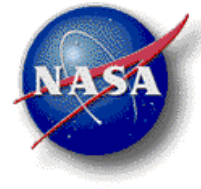
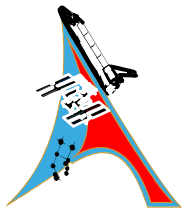
Malcolm Glenn
KSC S&MA SSP
Chief Engineer

Steve Minute
KSC Shuttle S&MA
Division Chief

Dan Mullane
MSFC S&MA SSP
Chief Engineer

Dan Dumbacher
Shuttle Assurance Department Manager (Acting)

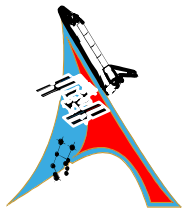
David Failla
SSC S&MA SSP
Chief Engineer



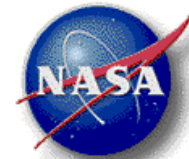
Independent Assessment Dissenting Opinion on T-O Umbilical Issue to STS-114 Flight Readiness Review

June 29, 2005

Phil Deans/JSC IA Office



Independent Assessment Dissenting Opinion on T-O Umbilical Issue

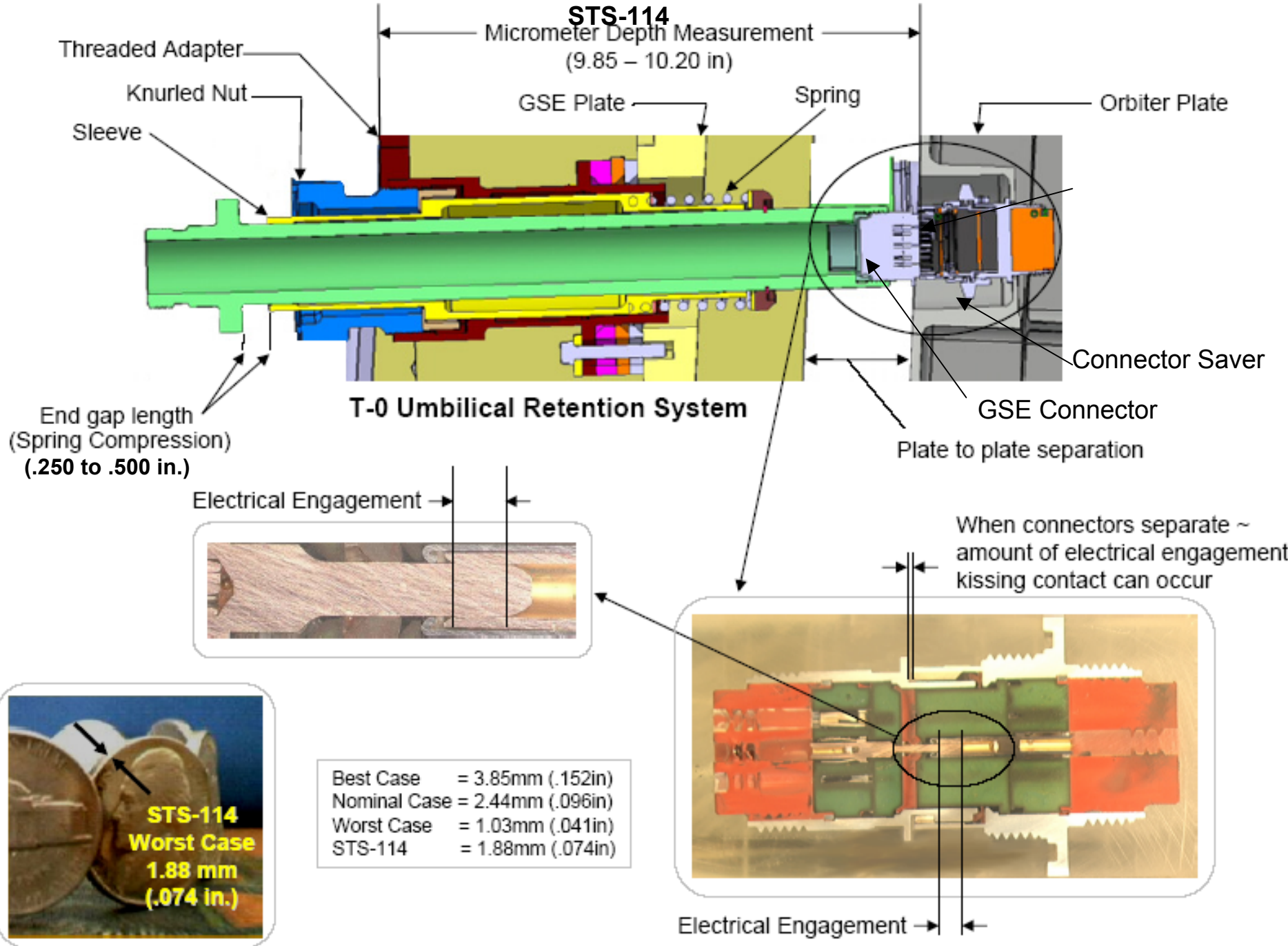


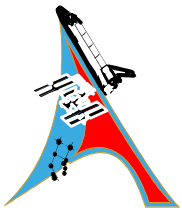
- **Launch Data:**

STS-112 Unexplained Anomaly – Space Shuttle Vehicle Release System A Fire 1 command failed to function at T-0. Previous Launch Anomalies: STS-105 LDB-1 lost during SSME start, STS-108 SRB LH Bus A erratic after SSME start, STS-110 SRB RH Bus A erratic after SSME start, and STS-111 SSME-3 EIU signal erratic at SSME start.

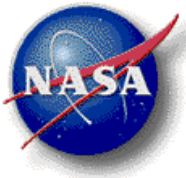
- **The Issue:**

Catastrophic risk from the common cause failure resulting in inadvertent plate / pin / socket separation and loss of electrical continuity to the SRB Hold Down Post Pyrotechnic Initiator Controller Fire 1, Fire 2, and Return paths across the T-O Umbilical due to the dynamic vibro-acoustic environment from SSME startup through T-0.



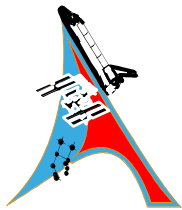


Independent Assessment Dissenting Opinion on T-O Umbilical Issue

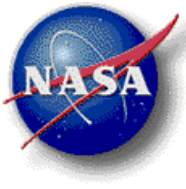


- **Risk Concerns for STS-114:**

1. Inadequate margin for electrical connector pin / socket engagement. One new STS-114 cable has less than 2 mm engagement. J56, pin J has 1.87 mm (thickness of a nickel) per Shuttle SE&I Office.
2. Unknown dynamic environment at HDP T-O connectors during SSME startup through T-0. (No test data to verify NESC vibration modeling analysis of 6/21/05 - max predicted dynamic displacement less than 0.060 in (1.5 mm). Analysis did not include all external forces and quasi static loading during the SSME startup and vehicle “twang” maneuver.)
3. Inadequate vibration test article, test Y axis only, and no low frequency vibration spectrum below 20 hertz used by STS-112 Standing Accident Investigation Board and SE&I Tiger Team.
4. Inadequate Certification and Qualification of the TSM Electrical System. (Spec requirement-no discontinuity greater than 10 microseconds, only 2 pins / connector monitored, none recorded).
5. Inadequate instrumentation at the T-O interface (electrical continuity or connector movement) during SSME startup through T-0.



Independent Assessment Dissenting Opinion on T-O Umbilical Issue



- **STS-114 Recommendation**

Increase the electrical pin engagement length to accommodate the unknown dynamic extraction potential and increase pin/socket electrical engagement margin. This is applicable to 4 pins (HDP) in four connectors J60, J56, J61, and J53.

Note: This Dissenting Opinion was brought forward to the 3/31/05 Shuttle PRCB by Phil Deans (JSC), Mac Himel (JSC), and Bowes Channell (MSFC – deceased 4/23/05), and subsequently to the STS-114 SMARR, and JSC Center Director.



SPACE SHUTTLE PROGRAM

Space Shuttle S&MA Office

NASA Johnson Space Center, Houston, Texas



STS-114 Flight Readiness Review

Presenter

Alex Adams

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Backup Charts



| | | |
|--|--|--|
| STS-107 | | Presenter Alex Adams |
| Baselined Hazard Cause Classification | | Date June 30, 2005 Page 16 |

HAZARD SEVERITY AND LIKELIHOOD OF OCCURRENCE WITH CONTROLS IN PLACE

| | | | | |
|------------|------------|-----------------|----------|--------------|
| Likelihood | PROBABLE | 1 | | 0 |
| | INFREQUENT | | 37 | 2 |
| | REMOTE | 62 | 23 | 367 |
| | IMPROBABLE | 222 | 455 | 4198 |
| | | MARGINAL | CRITICAL | CATASTROPHIC |
| | | Severity Levels | | |

Probable x Catastrophic Causes

- none

Probable x Marginal Causes

- Phenolic ply distortions/fiber orientation/low threshold material

Infrequent x Catastrophic Causes

Debris:

1. Meteoroid and Orbital Debris Impact
2. Impact Damage to Radiator Panels due to Meteoroid and Orbital Debris

Total Causes
Accepted Risk: 430
Controlled Risk: 4937



Exception: Hazard Reports

Presenter **Alex Adams**

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Orbiter:

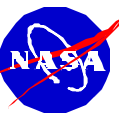
- | | |
|--|------------|
| 1. ORBI 345, Impact of loose TPS inspection/repair tool | PRCB OSB |
| 2. ORBI 349, EVA Hazards resulting from TPS Inspection | PRCB OSB |
| 3. IBA01000, EVA Contact Hazards (CN) | PRCB OSB |
| 4. IBA02000, Electrical Hazards (CN) | PRCB OSB |
| 5. IBA05000, Fire/Explosion (CN) | PRCB OSB |
| 6. IBA08000, Mechanical Hazards (CN) | PRCB OSB |
| 7. IBA09000, Structural Hazards (CN) | JSERP 6/28 |
| 8. LCS001, Crew eye injury - Laser Radiation (CN) | PRCB OSB |
| 9. LCS002, Obstruction of external visibility (AR) | PRCB OSB |
| 10. ORBI 009, Loss of Thermal Panes (AR) | PRCB OSB |
| 11. ORBI 108, Over-pressurization of the Orb. Aft Fuselage | PRCB OSB |
| 12. ORBI 194, Erroneous General Memory Read/Write | PRCB OSB |

Request SFOC provide verification for integrated loads assessment 6/28

- Cycle Ergometer Mounting Fixture
- Trash Container
- Pre-Routed Cables
- Umbilical Well Camera Attachment
- Aft Fuselage Gas Sample System

Request SFOC provide controls and verifications 6/28

- Yellow/Yellow Hose Assembly – H2 supply pressure
- ET Sep & Umbilical Well Camera – Nitrogen Purge
- SOMS Contamination Kit – H2O supply pressure
- RMS IFM D&C Kit – Pin to pin assessment
- Payload Bay MPLM Micro-TAU – Bond Verification
- CIPA/NOAX/Emittance Wash material compatibility with Payload Bay Hardware



Exception: Hazard Reports

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Vehicle Integration:

- | | |
|--|------------|
| 1. IDBR-01: Integrated Debris | ISERP 7/01 |
| 2. ISPR-02: ET Vent Arm System (ETVAS) Umbilical Malfunction* | ISERP 6/28 |
| 3. IEPD-01: Inability to Power Critical Functions* | ISERP 6/28 |
| 4. IMPS-15: LO2 Geyser Event during Cryo Loading* | ISERP 6/28 |
| 5. IMPS-05: Over pressurization of the Integrated MPS H2 System | PRCB OSB |
| 6. IMPS-06: Under pressurization of the Integrated MPS H2 System | PRCB OSB |
| 7. IMPS-08: Under pressurization of the Integrated MPS O2 System | PRCB OSB |
| 8. IMPS-12: Excessive O2 from ET External to SSV | PRCB OSB |
| 9. IMPS-17: Inadvertent SSME Shutdown | PRCB OSB |
| 10. IFSI -02: ET/Orbiter System Interface Failure | PRCB OSB |
| 11. IFSI -03: SSME/Orbiter System Interface Failure | PRCB OSB |
| 12. IVLD-02: System Instability Results in Structural Failure of SSV | PRCB OSB |
| 13. * ET Feed Line Bellows Heater Addition | |



Exception: Hazard Reports

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GFE Shuttle:

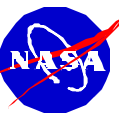
1. RMS In-Flight Maintenance D&C Kit SMART,
2. Locking Fasteners & Battery Box Orb. Aft Fuselage Gas Sampler Sys
3. Umbilical Well External Tank TPS Camera
4. Pan Tilt Unit
5. EVA IR Camera
6. RMS Sideview Camera Illuminator
7. EVA Digital Camera
8. Shuttle Cycle Ergometer
9. RCC Plug
10. RCC Crack Repair Material
11. Emittance Wash Material
12. Tile Repair Material (STA-54)

PRCB ECD 6/30
PRCB 7/9
PRCB OSB
PRCB ECD 7/9
SMART PRCB ECD 7/8
PRCB OSB
PRCB OSB
SMART, PRCB ECD 6/27
SMART, PRCB OSB ECD 6/28
SMART, PRCB OSB ECD 7/01
SMART, PRCB OSB ECD 6/30
SMART, PRCB ECD 6/3

EVA:

1. CIPA Tile Repair - 5 (EVA Capable)
2. RCC Repair - 1 (EVA Capable)
3. Emittance Wash - 1 (EVA Capable)

ECD 7/6/05



Exception: Hazard Reports

Presenter **Alex Adams**

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ET:

1. E.01 Electrical fires due to malfunctions
2. E.04 Malfunction of electrical heaters on the ET
3. E.06 ET RTF Instrumentation
4. P.05 GUCA separation malfunctions
5. T.02 Loss of ET Thermal Protection System
6. T.04 ET Ice Debris

Status:

6 Open Hazard Reports

All of the above have been approved through MSERP: Awaiting Program approval (OSB)

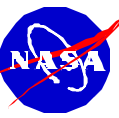
SRB:

1. C-00-04 Debris Impacts on ET or Orbiter (Update)
2. I-00-02 SRB Interface Debris Hazard Report (New)
3. C-30-01 inability to Successfully separate SRBs leads to re-contact
4. B-60-12 Debris impacts ET or Orbiter
5. C-30-05 Failure leads to ET structural damage
6. B-20-04 /A-20-24 Hydrazine source in the presence of an ignition source

Status:

6 Open Hazard Reports

All approved by MSERP but pending PRCB approval (6 OSB)



Exception: Hazard Reports

Presenter **Alex Adams**

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SSME:

Update Hazard Reports to include Knife Edge Seal debris as a FOD source. The update has been approved by Level III and the MSERP. PRCB approval pending.

RSRM:

Rebaseline BC-11, Primary and Secondary Debris

- Approved by MSERP and RSRM Project (Level III)
- Submitted to PRCB (ECD: 07/7/05)

Stellar OPT Implementation

- Safety Issue Briefing approved by MSERP and RSRM Project (Level III)
- NSTS-07700, Volume V waiver submitted to PRCB OSB

Nozzle Fastener Corrosion Issue

- Safety Issue Briefing approved by MSERP and RSRM Project (Level III)
- NSTS-07700, Volume V waiver submitted to PRCB OSB



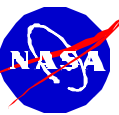
| | | |
|------------------------|-----------------------------|----------------|
| Exception: CILs | Presenter Alex Adams | |
| | Date June 30, 2005 | Page 22 |

Orbiter:

- | | |
|----------------------------|------------|
| - IBA – 45 CILs | JSERP 6/24 |
| - ET Purge Curtain (1 CIL) | PRCB 7/07 |

GFE:

- | | |
|--|----------|
| - Life Raft Unit (LRU) CIL – 2 CILs | PRCB OSB |
| - Enhanced Life Preserver Unit (ELPU) – 2 CILs | PRCB OSB |



Exception: CILs

Presenter **Alex Adams**

Date **June 30, 2005** Page **23**

ET:

Bellows heater CIL updates

- One new CIL – Crit 1 for debris
- Revise TPS CIL to reflect new TPS closeout

ET CIL Volume V, 47 TPS CILs – all open work complete - -to be submitted with Bellows heater CILs

Status:

Approved through MSERP: Awaiting Program approval (OSB).

SRB:

There are a total of 3 New SRB FMEA/CILs open for STS-114 approved by the MSERP and pending PRCB approval (OSB):

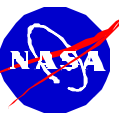
- 30-02-06-A03 Rupture or Burn-through of Motor (Aft BSM);
- 30-01-06-A03 Rupture or Burn-through of Motor (Forward BSM);
- 30-01-06-A02 Debris Impacts ET or Orbiter

There are 36 other FMEA/CIL updates that are pending PRCB(OSB) approval.

RSRM:

Stellar OPT Implementation (4 new CILs)

- Safety Issue Briefing approved by MSERP and RSRM Project (Level III)
- NSTS-07700, Volume V waiver submitted to PRCB OSB



Exception: Certification

Presenter **Alex Adams**

Date **June 30, 2005** Page **24**

Vehicle Integration

- Flight Acoustic Environment (6/29/05)

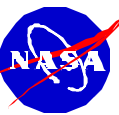
ET

- Bellow Heater certification paper

Status: Pending completion of test reports and documentation. Closure not expected prior to FRR. No issues identified in a preliminary assessment.

Orbiter

- OBSS/RMS - Fasteners that may have been yielded upon installation may not have sufficient remaining strength to prevent bolt failure under maximum loading (7/6/05)
- "Use-As-Is" analytical tools uncertainty (7/11/05)
- CAR 23-07-390001-001M Fwd Fuselage TPS (Windows)
- CAR 24-07-390001-001M Window/Windshield Inst. Thermal Pane – Thicker Side and Overhead Windows
- CAR 127-03-73A000015-1001F OMS/RCS Pod Structural Assy
- CAR 01-04-337792-001A (ERRATA) Overhead Audio Panel (IMU Access)
- CAR 26-07-190001-001W Wing TPS Installation
- CAR 26A-07-190001-001W Wing TPS Installation
- CAR 26A 07-190001-001W (ERRATA) Wing TPS Installation
- CAR 12-22-282-0082-0050Q (CD) Kevlar Overwrap Pressure Tank Life Extension
- CRR 22-282-0082-0050Q Kevlar Overwrap Pressure Tank Life Extension



Exception: Certification

Presenter **Alex Adams**

Date **June 30, 2005** Page **25**

GFE:

- | | |
|-------------------------------------|--------------------------------------|
| 1. Biomedical Systems (3) | ECD 06/30/2005 |
| 2. Camera Systems (9) | ECD 07/11/2005 (PTU Stress Analysis) |
| 3. Crew Escape Equipment (1) | ECD 06/24/2005 |
| 4. Displays & Controls (2) | ECD 06/30/2005 |
| 5. Energy Systems (1) | ECD 06/24/2005 |
| 6. Flight Crew Equipment (2) | ECD 06/27/2005 |
| 7. Laptop Computers (1) | ECD 06/24/2005 |
| 8. OBSS (2) | ECD 07/09/2005 (Stress Analysis) |
| 9. RCC Repair Materials (2) | ECD 07/06/2005 |
| 10. Tile Overlay (6) | ECD 06/30/2005 |
| 11. Emittance Wash Material (1) | ECD 07/06/2005 |
| 12. Tile Repair Material STA-54 (1) | ECD 07/06/2005 |
| 13. RMS (1) | ECD 06/30/2005 |

EVA:

1. CIPA Tile Repair - 21 (EVA Capable)
2. Reinforced Carbon Carbon (RCC) Repair - 13 (EVA Capable)
3. Emittance Wash - 1 (EVA Capable)
4. EMU - 1 (Full Certification) - EMU Service & Cooling Umbilical (ESCU)
5. Tools – 1 (Full Certification) – EVA Helmet Interchangeable Portable Light Battery (ECD 7/6/05)

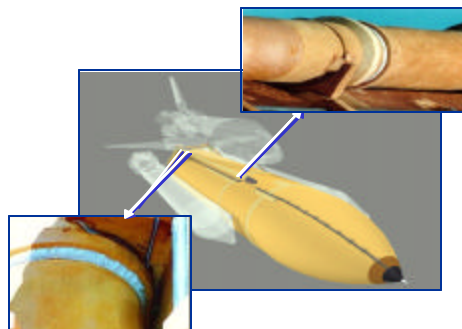
Exception: Interface Control Documents

Presenter **Alex Adams**

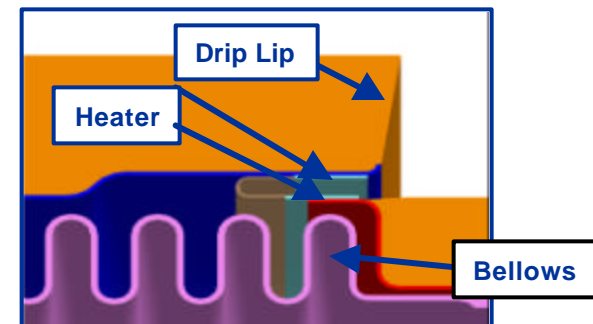
Date **June 30, 2005** Page **26**

- **ICD updates for ET Bellows heater**

- Added a heater to eliminate ice at the LO2 Feedline bellows cavity
 - Lockheed Martin recommended the elimination of LO2 Feedline bellows ice for RTF
 - Originated by LM Ascent Debris Minimization Independent Review Team (ADMIRT)
 - Accepted by ET RTF project as part of baseline redesign activity
 - Three bellows locations addressed for RTF
 - SSP SE&I/ET Project telecon on 12/02/04 informally directed LMC to pursue heater option for Sta. 1106 (Only) and drip lip only for Sta. 1979 and Sta. 2026



STS-107 Configuration



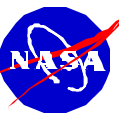
STS-114 Configuration



SPACE SHUTTLE PROGRAM

Space Shuttle S&MA Office

NASA Johnson Space Center, Houston, Texas



Exception: PRACA

Presenter **Alex Adams**

Date **June 30, 2005** Page **27**

Orbiter

~ 90 Open PRACA Items (as of 6-27-05)

GFE

- Crew Escape Equipment (2)
- Intensified TV Camera
- Flexible Confined Detonating Cord
- RMS Mechanical Arm Assembly

EVA

9 Open:

- CIPAA, Emittance Wash Applicator, BUCKLE
- Toxicity Level 4 Failure Investigation Action Reports that relate to containment must be resolved prior to flight (ECD 7/06/05)

ET

2 Open CAPS:

- T-075 Corrosion under primer
- T-077 Unauthorized primer used by supplier

SSME

Pending Approval of 1 Open UCRs as Closed or Deferred:

- Nozzle tube rupture



| | | |
|--------------------------|-----------------------------|----------------|
| Exception: Waiver | Presenter Alex Adams | |
| | Date June 30, 2005 | Page 28 |

ET

- Waiver - ET IVIS ESD Marking; presented and accepted at PRCB 6/16/05; pending PRCBD
- Waiver – NSTS 07700 Vol X waiver for ET debris (paragraph 3.2.1.2.14)



Exception: Limited Life

Presenter **Alex Adams**

Date **June 30, 2005** Page **29**

SRB Limited Life/Shelf Life Issue

- CDF Manifolds (Lot ABE) expiration date of 6/30; Extension Testing completed.
Lot certification ECD 6/28/05.



SPACE SHUTTLE PROGRAM

Space Shuttle S&MA Office

NASA Johnson Space Center, Houston, Texas



Exception: MRB

Presenter

Alex Adams

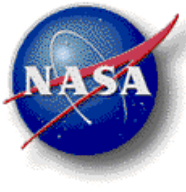
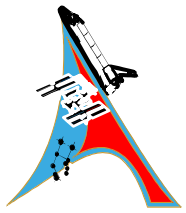
Date

June 30, 2005

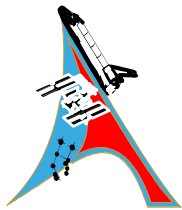
Page **30**

SRB

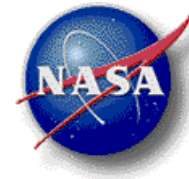
- There are currently 8 Open MRB Documents pending closure.



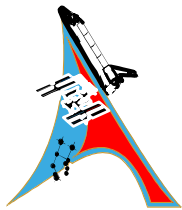
BACKUP



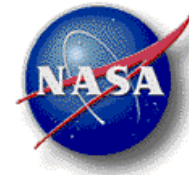
Failure Table



| Flight | Orbiter | MLP | Umbilical | Connector | Signature |
|---------|---------|-----|-----------|-----------|---|
| STS-105 | OV-103 | 3 | LH2 | J71 / | <div>1</div> Distorted PCMMU signal during S0009 power-up |
| | | | | J71 / | <div>2</div> LDB-1 lost during SSME start |
| STS-108 | OV-105 | 1 | LH2 | J61 / | <div>3</div> SRB LH Bus A erratic after SSME start |
| STS-109 | OV-102 | 2 | | | None |
| STS-110 | OV-104 | 3 | LH2 | J71 / | <div>4</div> { LDB I/O errors during S0008 power-up LDB I/O errors during S0009 power-up LDB-1 to LDB-2 switch during scrub de-tanking |
| | | | LO2 | J60 / | <div>5</div> SRB RH Bus A erratic after SSME start |
| STS-111 | OV-105 | 1 | LO2 | J64 / | <div>6</div> { SSME-3 EIU parity errors during ambient testing SSME-3 EIU signal recovered during cryo operations SSME-3 EIU signal erratic at SSME start |
| STS-112 | OV-104 | 3 | LH2 | J61 / | <div>7</div> HDP System A fire 1 command failed at T-0 |
| STS-113 | OV-105 | 2 | | | None |
| STS-107 | OV-102 | 1 | | | None |



Independent Assessment Dissenting Opinion on T-O Umbilical Issue Electrical Concerns

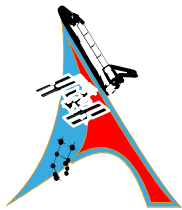


1. Inadequate Electrical Connector Pin / Socket Engagement Design Margin.

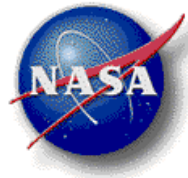
- Boeing analysis established worst case pin / socket electrical engagement of 1.0287 mm (0.0405 in.).
- Additional Boeing analysis establishes STS-114 worst case electrical engagement for SRB HDP cables is 1.88 mm (0.074 in.).

NOTE: Engagement is less than the nominal 2.44 mm (0.096 in.)

- The Connector Saver contributes a greater amount of tolerance stack-up than the NB Connector and the rounded pin.
- 1.88 mm of electrical pin / socket is considered inadequate to accommodate the combined dynamics, at the Plate location, from SSME startup to T-0.
- The dynamic environmental affect and marginal pin / socket electrical engagement poses a common cause failure condition that affects all critical redundant connectors.
- Based on previous failure history half of the T-0 signal failures occurred following SSME start.

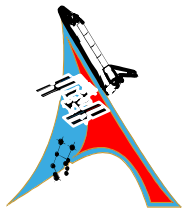


Independent Assessment Dissenting Opinion on T-O Umbilical Issue Electrical Concerns



1. Inadequate Electrical Connector Pin / Socket Engagement Design Margin (cont'd).

- Previous investigation concluded corroded pins to be one of the most probable causes.
- Troubleshooting of T-0 signal failures has proven that disconnect / reconnect of cables reestablished conductivity (cleaning procedure ineffective).
- No Analysis or test has been performed which conclusively proves that Corrosion is the only cause of the discontinuities experienced.
- Electrical Connector “kissing contact” between the pins and the sockets is still a viable failure cause that would pass all our electrical checks / screens, e.g. continuity, insulation resistance (IR), & di-electric withstanding voltage (DWV) and subsequently becomes open/intermittent during SSME startup.
- NESC White Paper, Hardware and Processing Changes, (2), page 2: *“The intermittent and random nature of the failures is consistent with presence of corrosion by-products on electrical hardware”*
 - Current knowledge of minimal pin engagement and allowable tolerances, “kissing contact” would exhibit the same intermittent and random nature of failures.

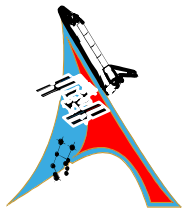


Independent Assessment Dissenting Opinion on T-O Umbilical Issue Electrical Concerns



1. Inadequate Electrical Connector Pin / Socket Engagement Design Margin (cont'd).

- The vibration test results are being used as the primary justification to not consider a longer pin re-design for STS-114.
- With the exception of assuring no corrosion, the identical electrical connectors with known wide tolerances will be used on STS-114 unless pins are redesigned.
- A longer pin design change was assessed at MSFC in November 2004, but the activity was terminated by SE&I in December 2004.
- A longer pin design change could possibly be accomplished if placed on program highest priority, and the four HDP cables could be changed out at the Launch Pad.

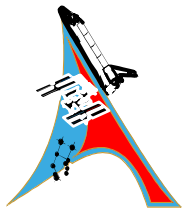


Independent Assessment Dissenting Opinion on T-O Umbilical Issue Mechanical Concerns



3. The Existing Vibration Test Article is Not an Adequate Simulation of the Full Scale Launch Vehicle and its Vibro Acoustic Response.

- Vibration fixture simulated GSE and ORB plates are restrained / bolted together in torque box that doesn't allow relative movement between plates as opposed to the flight vehicle plate response.
- The recent laser and eddy current instrumentation and their mounting brackets on the GSE electrical umbilicals adds mass that affects the dynamics, and the reliability of measured data.
- Vibration SSME low frequency Response Testing below 20 Hz minimal with some 5Hz steady state and a sine sweep 2 to 100 Hz.
 - During the sine sweep the accelerometer traces indicated a peak response @ 2.2 Hz of 0.38 G/Hz and @ 3 Hz of 0.35 G/Hz which is also consistent with some earlier SSME testing.
 - Past history on the Space Shuttle Vehicle (SSV) has demonstrated significant load response issues below 10 Hz.
 - Low frequency responses may couple with GSE electrical spring assembly as well as the T-O umbilical plates.
- There are two separate dynamic responses during SSME startup:
 - Electrical umbilical mass reaction to system dynamic response.
 - Dynamic separation of the T-O umbilical plates.

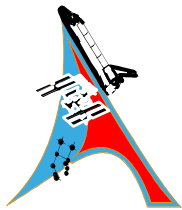


Independent Assessment Dissenting Opinion on T-O Umbilical Issue Mechanical Concerns

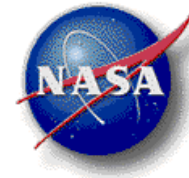


3. The Existing Vibration Test Article is Not an Adequate Simulation of the Full Scale Launch Vehicle and its Vibro Acoustic Response (cont'd).

- The coupling of these 2 forcing functions are not simulated by the vibration test leading to false conclusions.
- The test article only simulates one of 12 connectors per LH2 or LO2 full scale 4 ft. x 6 ft. plates and not the relative movements one would see on the vehicle.
- The electrical connector interface sees acoustic / vibration in all 3 axes as well as inertia effects while tracking in this dynamic pre-launch environment. The test article was vibrated only in the Y axis.
- There are obvious scaling effects that can only be sorted out with all SSME's firing during a FRF or the actual flight itself with adequate instrumentation to validate FEM / TMM models and verify no electrical discontinuities on all active circuits monitored down to T-0.
- NESC White Paper (Page 2, Testing) Confirms the IAD Concern. "...IAT concerns that this test setup did not fully model the interface because it did not permit relative motion between the two umbilical plates are not without merit, ..."



Independent Assessment Dissenting Opinion on T-O Umbilical Issue Electrical Concerns



4. Inadequate Certification and Qualification of the TSM Electrical System.

- Certification and Qualification tests from 1976 thru 1997 focused primarily on the Mechanical T-O interface Systems and the umbilical tracking / retraction system.
- The requirement for electrical connectors was to have no discontinuity greater than 10 microseconds in duration, for all pins in all connectors.
- During all Cert / Qual tests only 2 Pins in each connector were checked; overall, only 3.6% of the pins in the 55 pin connectors were tested.
- During Cert / Qual tests, thousands of analog recordings of mechanical performance data were analyzed, but no analog recordings of electrical signals was performed.
- During the Phase II Qualification Test in 1989, for SSP Upgrades, the LO2 Plate Connector Savers were not installed and the cables were not tested during the test.
- Connector savers were used outside their original specification because they were never certified at the component level without locking rings and were never properly certified to be used as launch separation interfaces.